THE BULLETIN

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Hydro-Electric Power Commission of Ontario

NOVEMBER 1920

Electrical Development Company Generating Station

THE BULLETIN

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Hydro-Electric Power Commission of Ontario

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Toronto Power Company Purchase

ON December 4, 1920, an agreement was reached whereby the Toronto Power Company and subsidiary Companies were purchased by the Hydro-Electric Power Commission of Ontario and the City of Toronto, for a total sum of $32,734,000. Negotiations in connection with the purchase of the Utilities controlled by the Toronto Power Company have extended over a period of approximately two years.

The expenditure by the City of Toronto was placed before the ratepayers at the municipal elections for ratification, and, it carried by a very large majority, proving that the purchase deal was quite popular and was considered to be in the best interests of the City of Toronto.

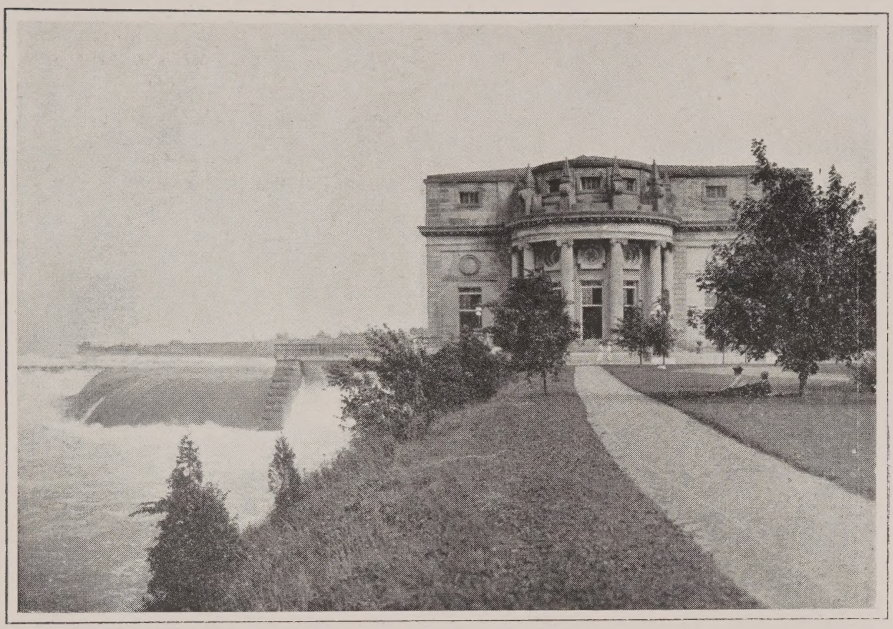
Method of Financing

The method of financing the purchase is clearly set out in the following letter from the Chairman of the Commission to the Mayor and Board of Control of the City of Toronto:

To the Mayor and Board of Control,
City Hall, Toronto.

Gentlemen: After investigation by the engineers and accountants of the Commission of the properties and businesses of the Toronto Power Company, the Electrical Development Company, the Toronto Electric Light Company, the Toronto and Niagara Power Company, the Toronto and

Generating Station, Electrical Development Company, Niagara Falls, Ontario.



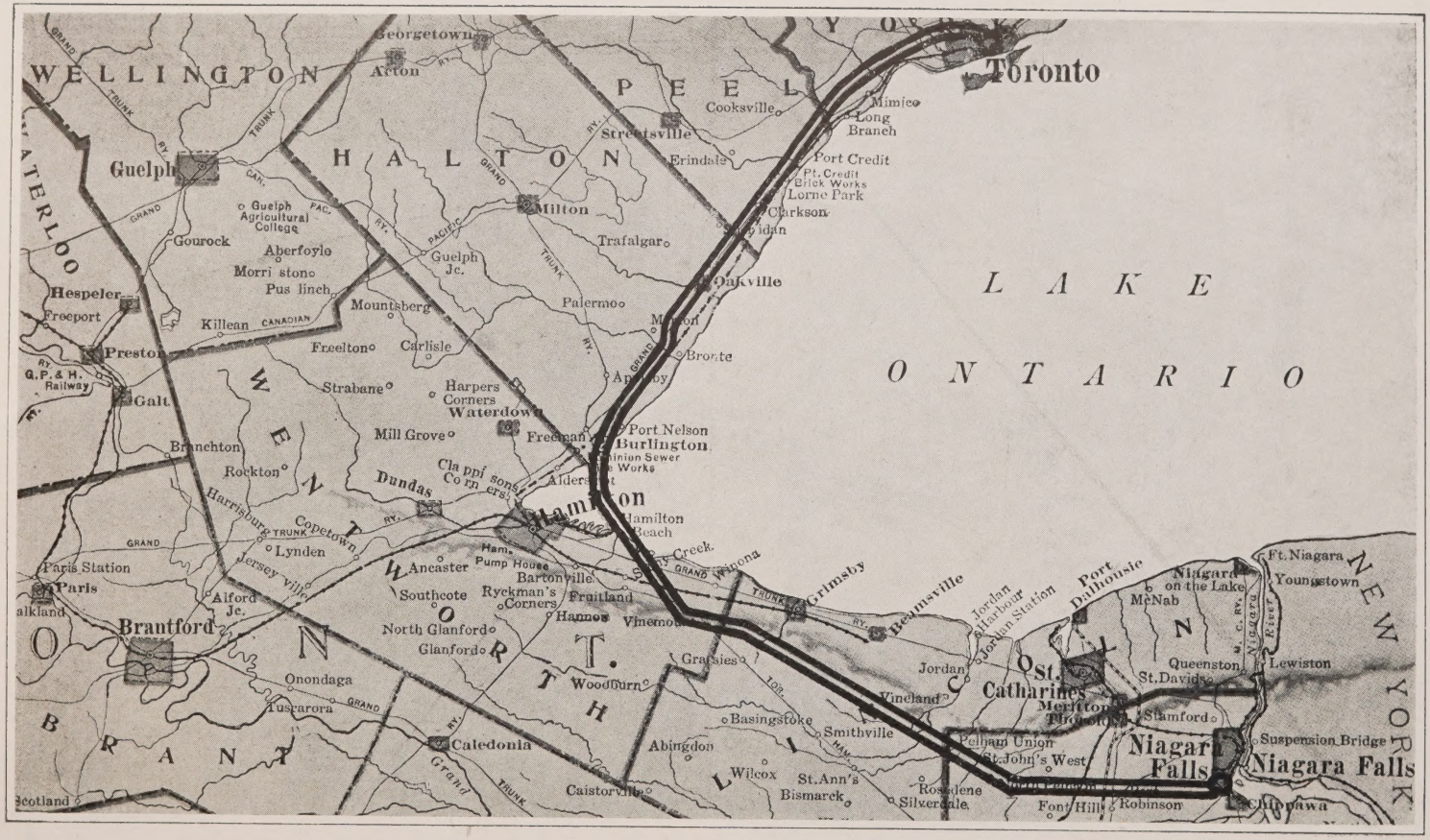
Electrical Development Company.

York Radial Railway Company and the Schomberg and Aurora Railway Company, and after negotiations extending over a period of more than a year, with the Toronto Railway Company, which owns or controls the same, the company has signified its willingness to dispose as of December 1, 1920, of the undertakings of the said companies, free from liability, except certain assets and liabilities specified by the vendors, to the Hydro-Electric Power Commission, acting for and on behalf of the municipalities comprising the Niagara system and the City of Toronto, at the price of $32,734,000. This involves the purchase of the following properties:

1. For and on behalf of the municipalities comprising the Niagara system:

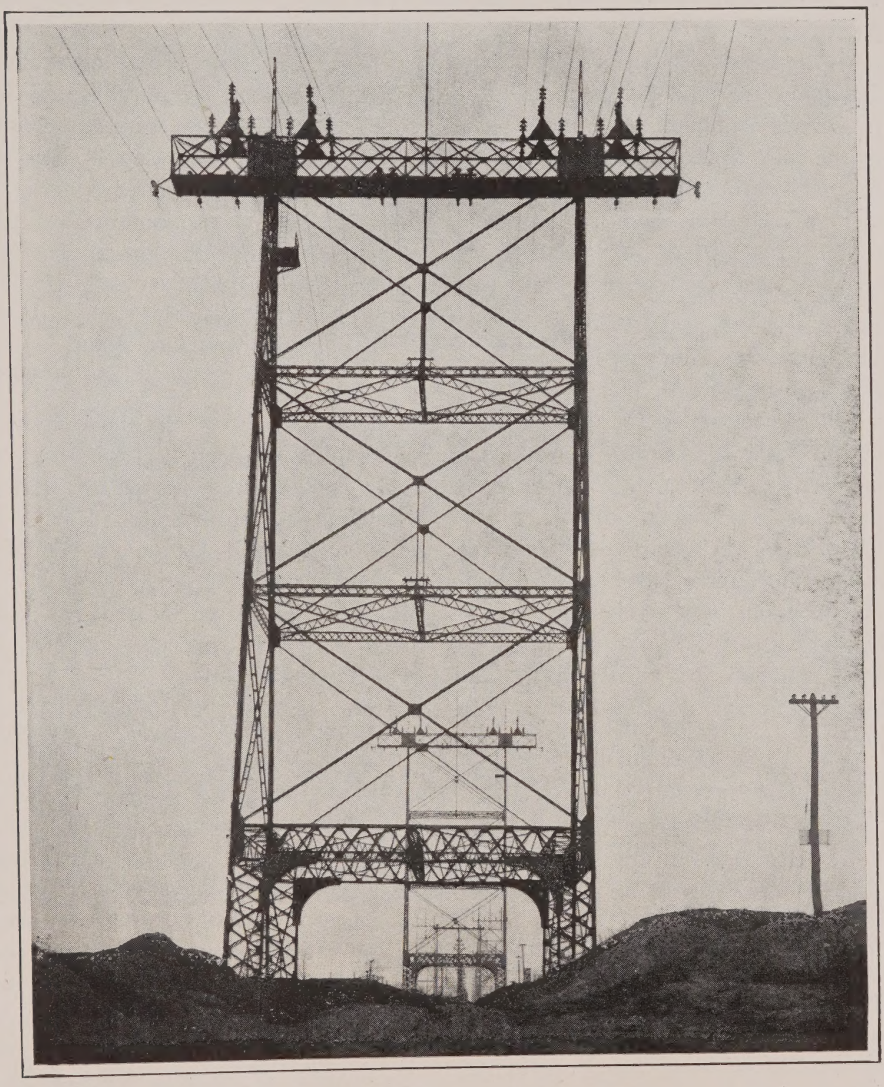
The Electrical Development Company's generating plant at Niagara Falls, the Toronto and Niagara Power Company's transformer stations and transmission lines and the steam plant, lands and property in the City of Toronto, at a total price of $22,547,705, to be paid by the assumption of the outstanding securities of the Toronto Power Company and the Electrical Development Company, amounting to approximately $21,935,177, and by the issue of bonds of the Hydro-Electric Power Commission, guaranteed by the Province of Ontario, for the balance.

2. For and on behalf of the City of Toronto. (a) The distribution system of the company in the City of Toronto at the price of $7,226,295, and the section of the Metropolitan division of the Toronto and York Radial



Map showing transmission lines of the Toronto Power Company.

Railway Company within the city (limited to what lies on the highway) at the price of $585,000, or a total of $7,811,295, to be paid by the assumption by the city of 6 per cent. bonds against the property of the Toronto Electric Light Company to the extent of approximately $840,000, due $30,000 every three months until 1922, when the balance thereof matures, and by the issue of 20-year 6 per cent. bonds of the City of Toronto for the balance; provided that the city will transfer to the commission the right of way and the physical assets it now owns within the city on the Kingston



High tension transmission line of Toronto Power Company crossing over Welland Canal.

road to the Woodbine and on the Lake Shore road from the Humber to Sunnyside.

Owing to the inability of the Toronto Power Company to free the Toronto Electric Light Company's properties from bond mortgages given by the Toronto Power Company, the said properties must remain subject thereto until the bonds of the Toronto Power Company are paid off when the said properties will pass to the city; and in the meantime the right of the city to receive the properties upon payment of the said bonds is to be confirmed by act of the legislature.

(b) The properties of the Toronto and York Radial Railway Company, including the Metropolitan division (except the section on the highway within the city limits), the Scarboro division and the Mimico division, for the sum of $2,375,000, to be paid by the issue of the bonds of the Hydro-Electric Power Commission, secured as provided under the Hydro-Electric Railway Act, by the issue and deposit by the City of Toronto of an equivalent amount of debentures, and guaranteed by the Province of Ontario.

As to these railways, it will be necessary that the agreement to be entered into should provide that the municipalities interested therein will be given an opportunity of voting under the Hydro-Electric Railway Act to acquire their proper interest, and their acceptance will proportionately reduce the amount to be now assumed by the City of Toronto.

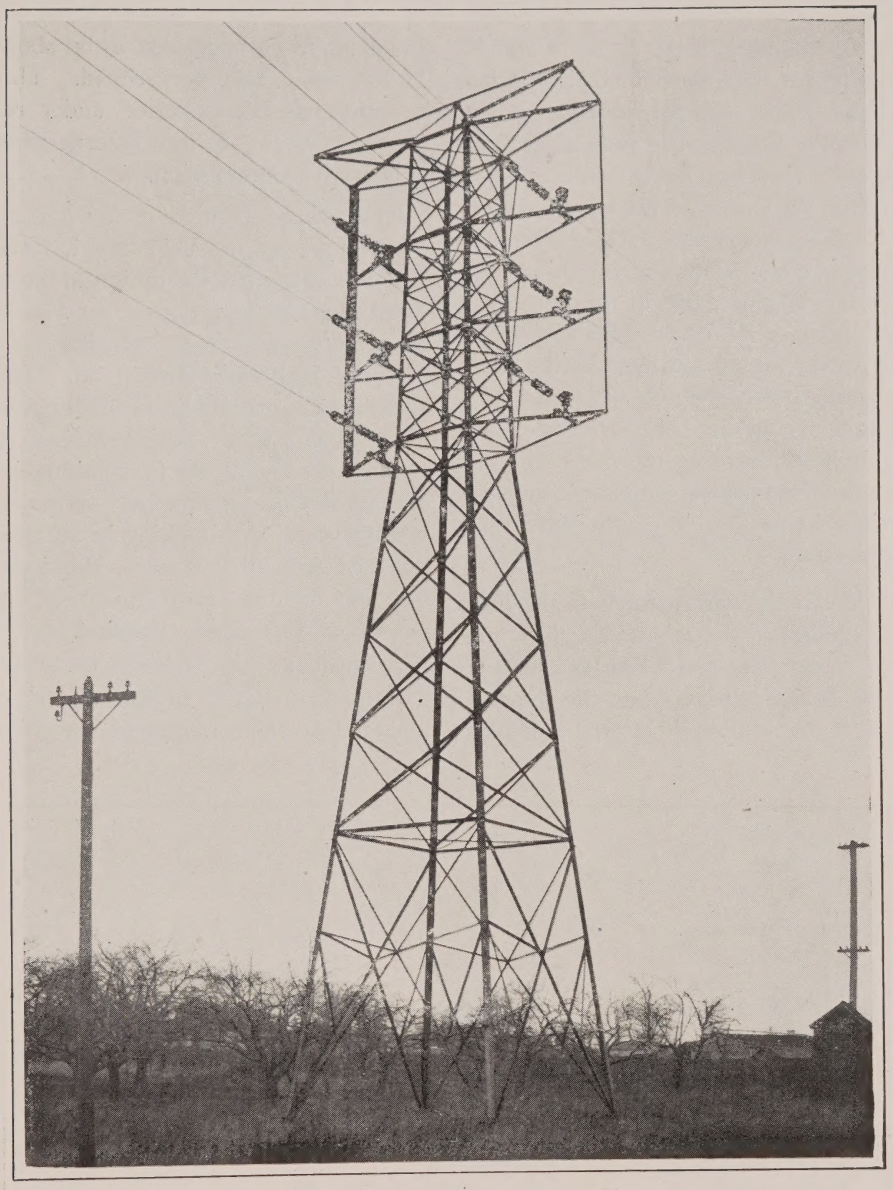
The government has given its approval and has stated that it will pass such orders-in-council and submit such legislation as may be necessary to carry out and validate the transaction.

After due consideration, the commission has decided to recommend, subject to such further investigation as is thought advisable by counsel for the commission and to the preparation of a satisfactory formal agreement with the vendors, the purchase of the above properties, and further recommends that the necessary by-law be submitted to the qualified voters of the City of Toronto authorizing the city to carry out the proposals outlined in paragraph 2.

Yours truly,
ADAM BECK,
Chairman.

On January 29, 1903, the Commissioners of the Queen Victoria-Niagara Falls Park entered into an agreement with "a Syndicate" composed of William MacKenzie, Henry M. Pellatt, and Frederic Nicholls, granting them privileges expressed in part as follows:—

> For the purpose of generating electricity and pneumatic power, or any other power to be transmitted, and capable of being transmitted to places of the Park, the Commissioners hereby grant to the Syndicate, subject to the consent and approval of the proper authority, and save as herein limited, a license irrevocable to take from the waters of Niagara River within the Park a sufficient quantity of water to develop 125,000 electrical, or pneumatic, or other power for common use.



Angle Tower, Toronto Power Company's H.T. transmission line.

On February 18, 1903, by Royal Letters Patent, under the Ontario Companies Act, the Syndicate was consolidated into the Electrical Development Company of Ontario, Limited.

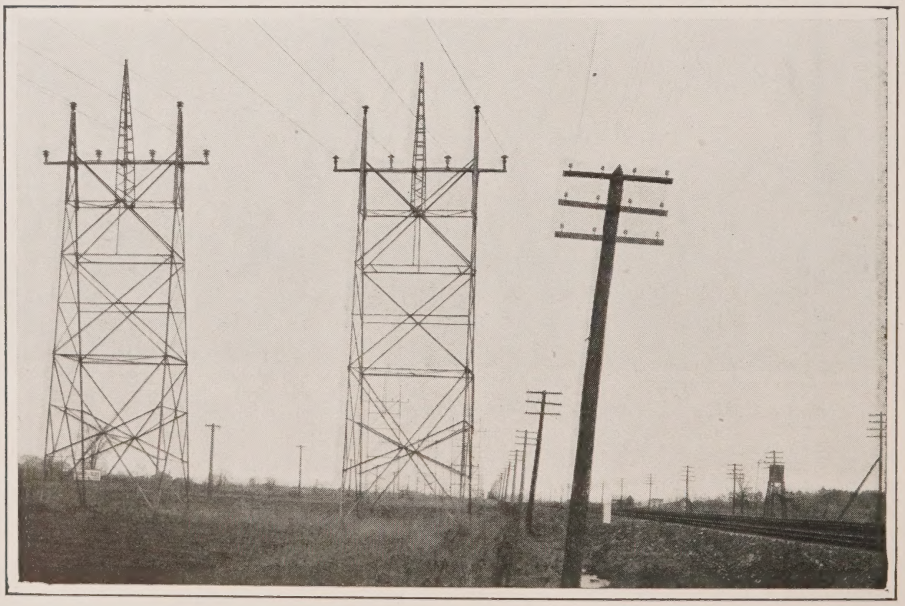
On March 21, 1903, the Syndicate above mentioned assigned its rights under the agreement of January 29, 1903, to the Electrical Development Company.

On January 9, 1905, the Commissioners of the Queen Victoria-Niagara Falls Park, entered into agreement with the Electrical Development Company, whereby the company was to utilize the waters of the Niagara River for the development of 125,000 horsepower under terms and conditions corresponding to those in the agreement of January 29, 1903. This agreement, however, was not ratified by the Lieutenant-Governor-in-Council, and, consequently never became valid. The purchase clears up the matter of dispute in connection with the company's right to use water to the extent set out above.

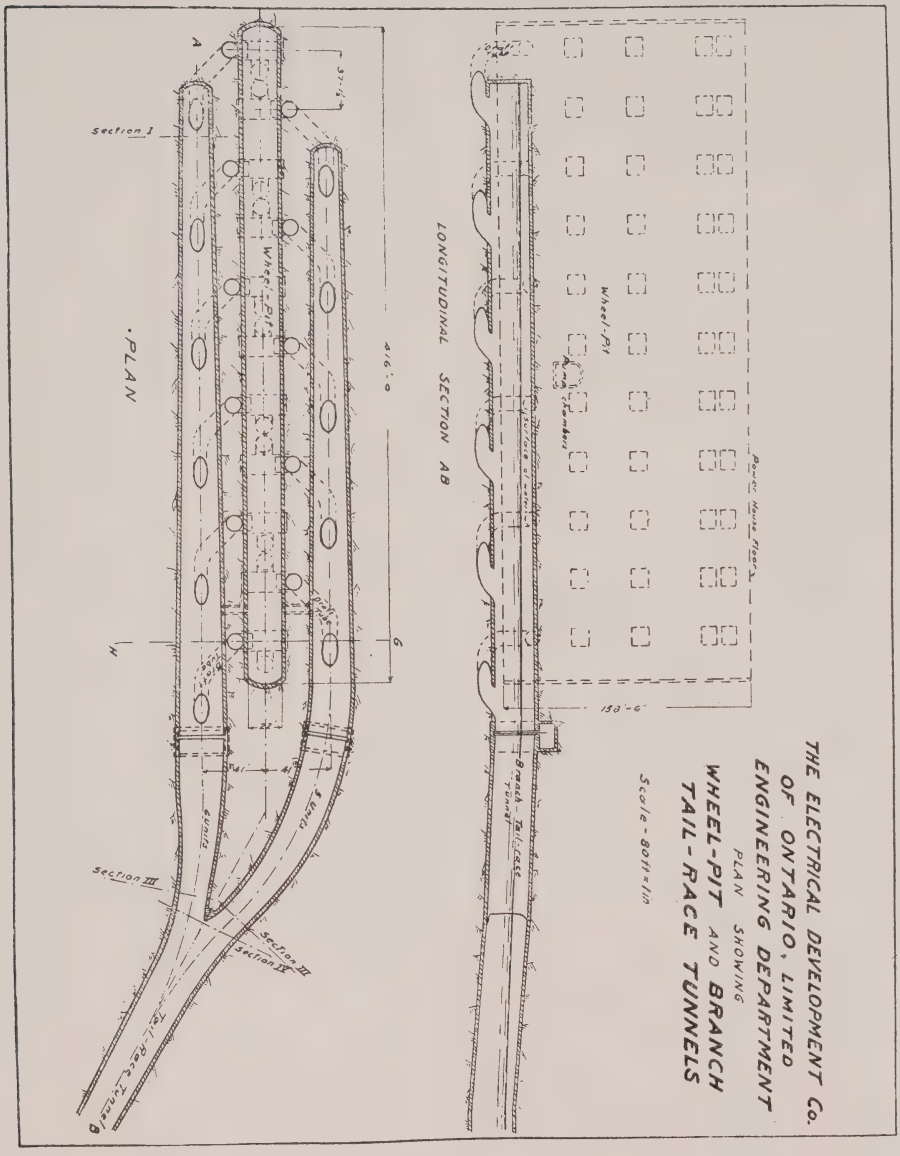
Under the agreement with the Park Commission, there is no fixed amount of water specified to be taken from the Niagara River, but the quantity of water required by the complete Plant has been computed to be about 11,200 cubic feet per second. This quantity has been allotted under recommendation of the International Waterways Commission.

The license granted is for a term of fifty years from February 1, 1903. The Syndicate has the option to make three renewals of the lease for a term of twenty years each, making one-hundred and ten years in all. The Lieutenant-Governor-in-Council has the option, under specific notice, to require the Syndicate to continue its operations for a further term of twenty years, thus making in all one-hundred and thirty years. Provision is made for the readjustment of renewals at each renewal period.

According to the terms of the lease, for the first 10,000 or less electrical horsepower, the company pays a year-



Toronto Power Company's line east of Oakville.



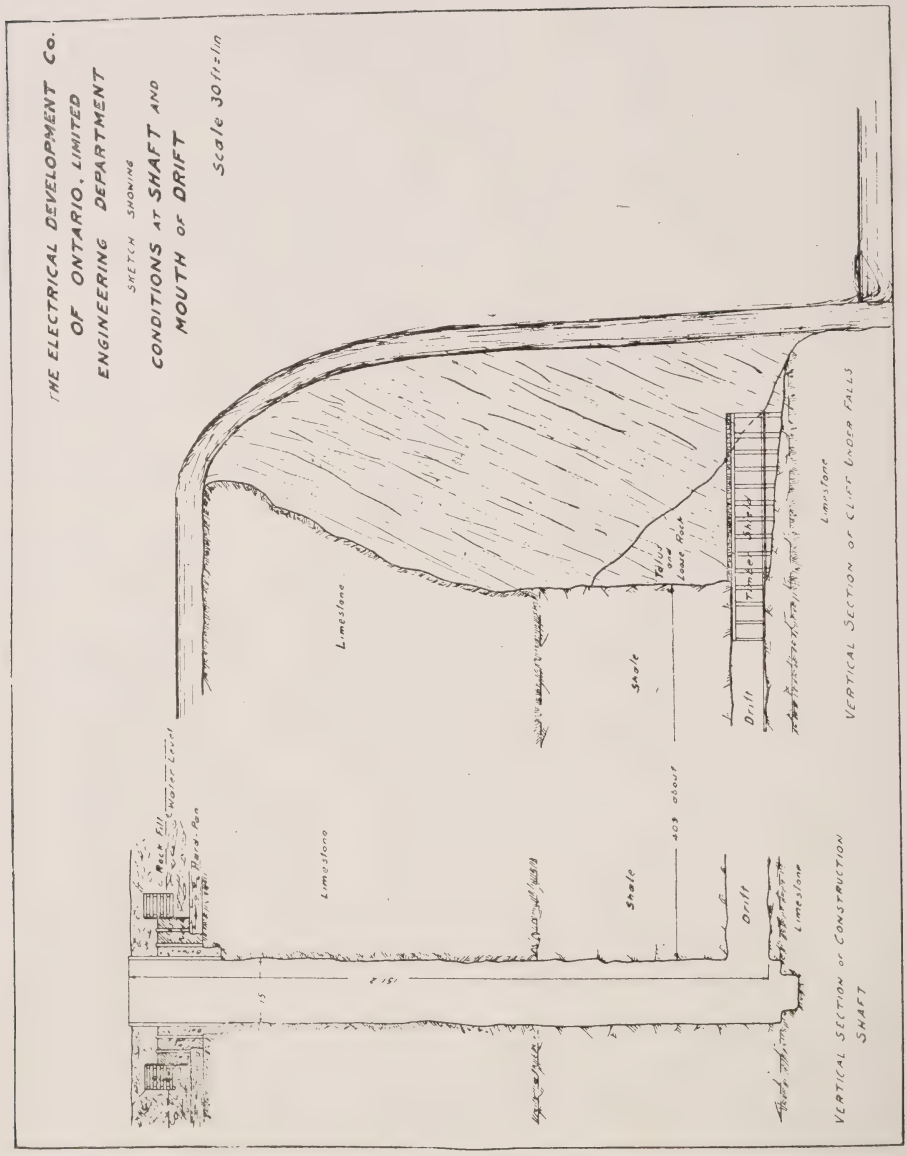
ly rental (payable half-yearly) of $15,000. For each additional electrical horsepower "generated and used, and sold or disposed of," the annual rental for each horsepower, shall be:—

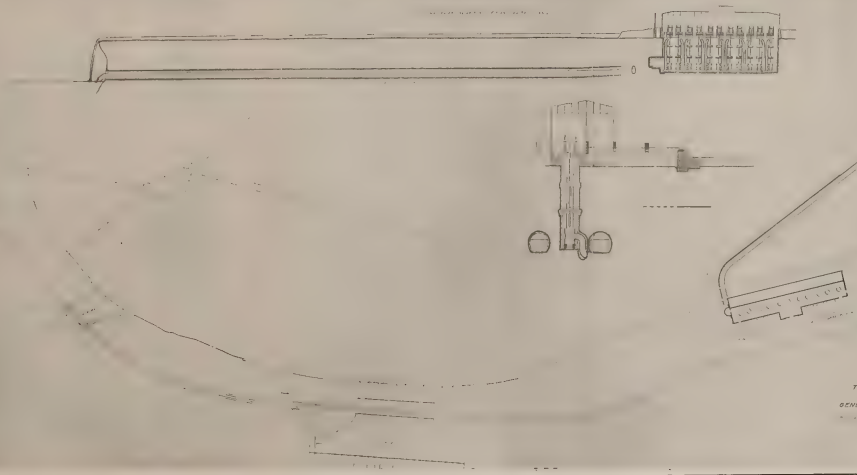
	per H.P.
From 10,000 H.P to 20,000 H.P.	$1.00
From 20,000 H.P. to 30,000 H.P.	.75
From 30,000 H.P. and over	.50

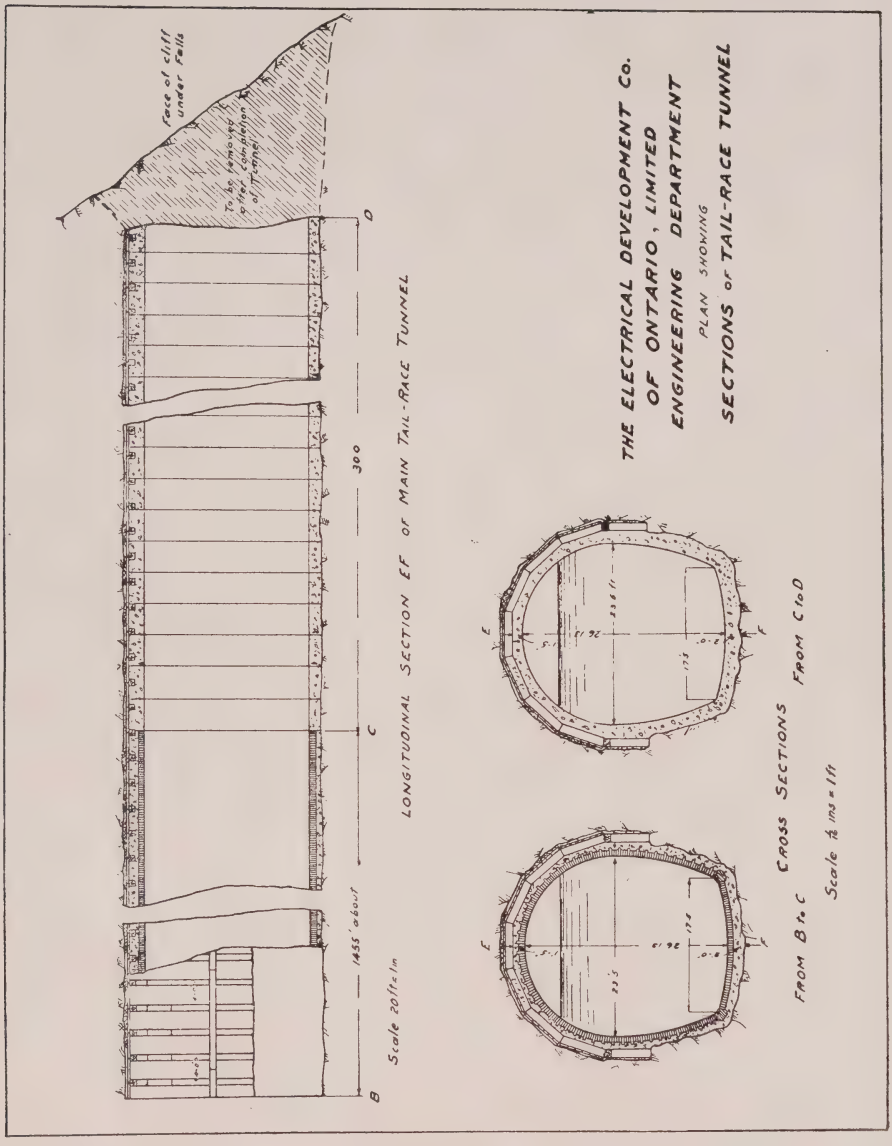
Generating Plant

The power plant of the Electrical Development Company was designed to utilize 11,200 c.f.s. of water under a head of 135.5 feet. The water is diverted from the Niagara River at Tempest Point, midway between the headworks of the Ontario Power Company and the Canadian-Niagara Power Company.

The water is gathered from the rapids by a wing dam, having a length of 785 feet and a maximum height of 27 feet—concrete with granite cop-




THE ELECTRICAL DEVELOPMENT COMPANY
OF ONTARIO LTD
GENERAL PLAN OF POWER DEVELOPMENT



ping. The elevation of the crest is 527 feet, and there is from 3 to 8 feet of water flowing over it, depending upon the condition of the river. Near the power house, the dam is cut away for a length of 30 feet to an elevation of 524 feet so that there is 3 feet additional depth of water to carry away the ice from the submerged arches in front of the power house. In addition to the first line of submerged arches, a second wall has been constructed outside of the racks. The spaces between the outer and inner walls, and between the latter and the racks, are arranged each with

a spillway at one end, so that such ice as passes through will float out at the north end of the building.

The wheel pit is 416 feet long and 22 feet in width inside of the brick lining, which is 2 feet thick, and is spanned by masonry arches at three levels to carry the machinery. The ends of the pit are also enclosed by arched wall linings.

The water, after passing through the racks, enters a cast iron bell-mouth, which, in turn, joins on to a riveted steel penstock, 10 feet 6 inches in diameter.

There are eleven penstocks, and, at the head of each, there is an electrically operated intake gate to control the water. The water wheels, built by the I. P. Morris Company, of Philadelphia, Pa., have a capacity of 15,000 horsepower each.

Each wheel unit consists of two Francis internal discharge turbines, 5 feet, 4 inches in diameter. The discharge of the water is governed by cylindrical gates and movable guide vanes, and the weight of the moving parts is partially taken care of by oil and water lubricated thrust bearings. The water wheels are so designed that the upward thrust also assists in carrying the weight of the moving parts.

There is a single cast iron draft tube, 9 feet in diameter, from each wheel, and the units alternately discharge water underneath the east and west tailrace tunnels. The object of the under discharge is to seal the draft tubes and prevent loss of vacuum, no matter what the elevation of the water in the tunnels may be, and without the necessity for a tailrace weir. By using two tunnels, it is possible to shut off the water entirely from one-half of the wheels without interfering with the other half. By closing down the wheels, discharging water into either tunnels, that tunnel will drain itself, and there is no necessity for closing off the mouth of the tunnel. A gate is provided at the mouth of both tunnels, however, in case of extreme back water, which has been known to be 50 feet above normal in the lower river.

As the wheel pit is not connected to the tail race, the hydraulic apparatus can never be flooded out.

The tunnels on each side of the wheel pit are 25 feet deep, and vary in width from 66 to 30 feet, with a velocity of from 15 to 21 feet a second. At a point about 105 feet north of the wheel pit, the tunnels come together. At the junction the tunnel is 35 feet wide and 25 feet 6 inches high, and tapers to a width of 23 feet 5 inches and a height of 26 feet 13 inches, which section is carried to the edge of the Falls, a distance of 1,935 feet. The slope of the main tunnel is .005, making a total loss of about 10 feet, and the velocity of the water is about 26 feet per second. The tunnels have a lining 2 feet thick throughout of concrete faced with brick, except for 300 feet at the north end, where the linning consists of concrete rings in 6 feet sections, which are expected to break off as the cliff gradually wears away. This is necessary, as the crest in the centre has been receding at an average rate of 2½ feet a year.

The water wheels are connected to electric generators through vertical shafts 150 feet long, consisting of

riveted steel tubes 30 inches in diameter between bearing and solid shafts 14½ inches in diameter at bearings. This shaft is held at three points in the wheel pit by steady bearings resting on concrete arches. At the upper end there is an oil thrust bearing 37½ inches in diameter fed by oil under a pressure of 350 pounds, which is sufficient to carry the weight of the entire revolving parts should the water thrust fail from any cause.

The following machines are installed in the generating station:—

Four, C.G.E. Co., Type A.T.B., class 12, 8,000 kw.—250, form V, 12,000-volt, full-load 385 amperes, 250 r.p.m., vertical type A.C. Generators, direct connected to I. P. Morris vertical water turbines, 13,000 H.P., 250 r.p.m.

Seven, C.G.E. Co., Type A.T.B., class 12, 1,000 kw.—250, form 15007, 12,000-volt, full-load 250 r.p.m., vertical type A.C. Generators, each connected to one I. P. Morris, 15,000 H.P., 250 r.p.m. vertical water turbines.

Each of the above mentioned Generators is equipped with one C.G.E. Co., Type M.P.C., class 6—50—250, 400 ampere, 125 volt, speed 250 r.p.m., vertical excitors.

Two, C.G.E. Co., Type M.P., class 8—300—500, form L., 125 volt, 2,400 ampere, 500 r.p.m., vertical type, D.C. Generators; each direct connected to one I. P. Morris, 500 H.P., 500 r.p.m., vertical water turbines with Blocker-White Governor, and one C.G.E. Co. Electric Control Rheostat.

One, C.G.E. Co., vertical motor generating set, equipped as follows:—

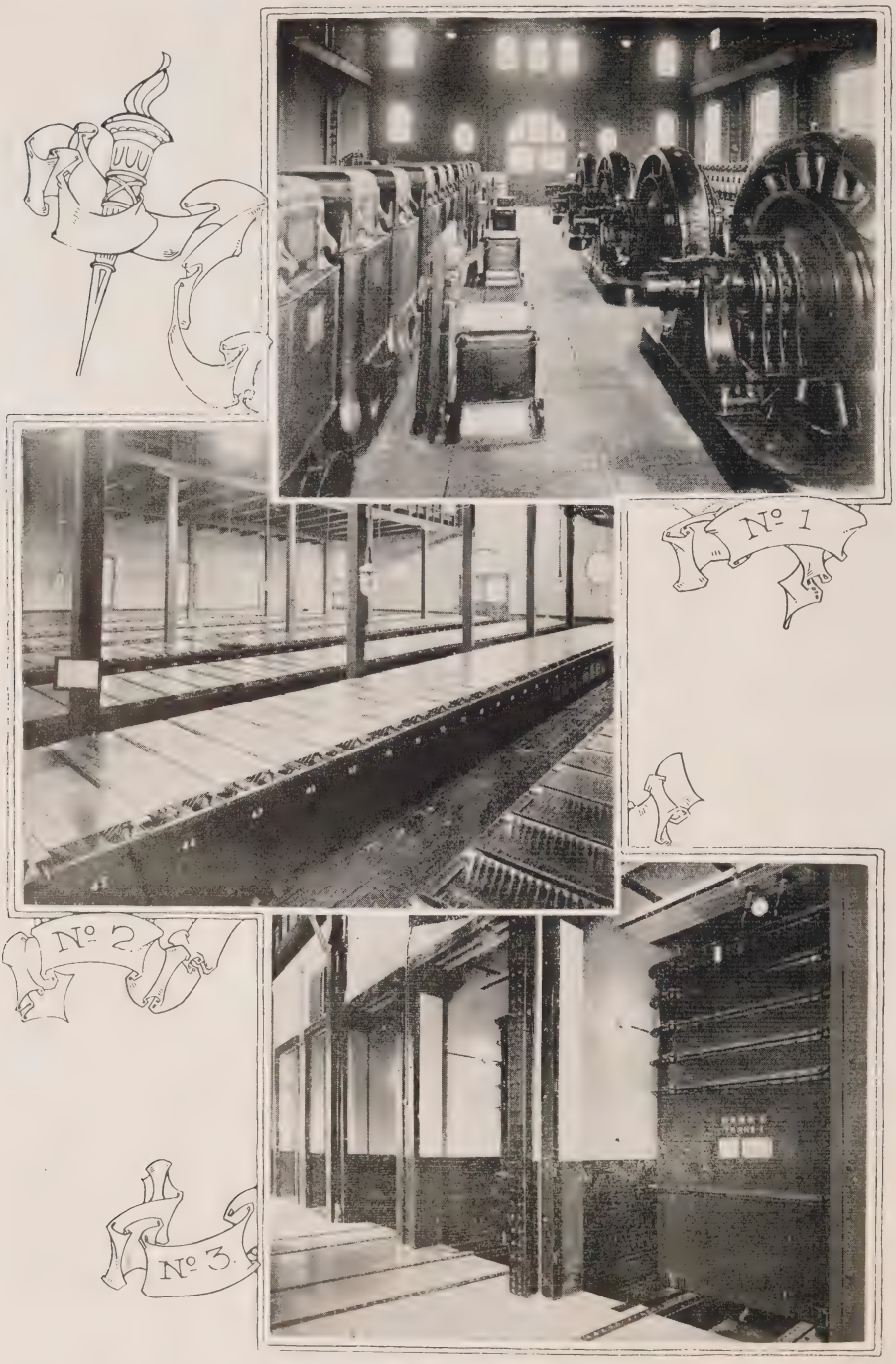
One, C.G.E. Co. Type I., class 6—450—500, form K., 25 cycle, 450 H.P., 220 volt, 102 ampere, 500 r.p.m., Induction Motor, direct connected to one C.G.E. Co., type M.P., class 8—300—500, Form L., 80 volt, no load, 2,400 ampere, 500 r.p.m., D.C. Generator.

The controlling switchboard for the entire plant, including transformers and transmission lines, is located in the centre of the power house, where the operator can see the generators. It consists of an enclosed apartment with a bench-board in front and doors at the ends. Dummy bus bars and signal lamps on the bench-board clearly indicate to the operator the connections in the station, and the instruments are so located that each is over the switch which controls them. The power house bus bars, generator oil switches, instrument and switch transformers are located immediately below the power house floor in brick compartments. The wiring arrangement is such that a generator can either be connected to the bus bars or direct to outgoing feeders.

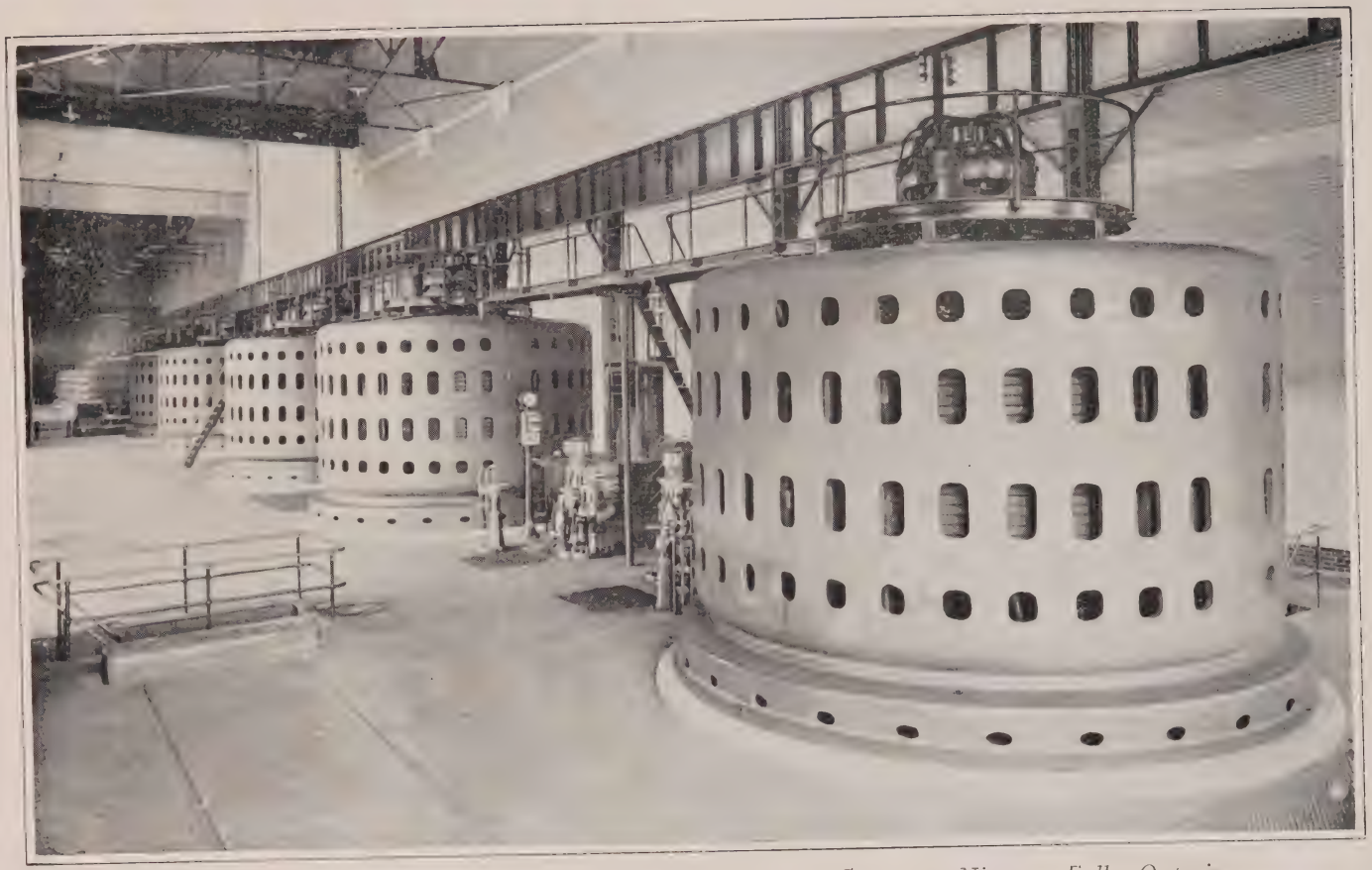
The power house is a handsome building in the style of the Italian Renaissance, constructed of Indiana Limestone, and is about 500 feet long and 70 feet wide. The height is approximately 40 feet, except at the centre and end bays. The centre bay stands out from the face of the building, and, besides being the main entrance, provides space for the offices of the Power Company.

Distributing Stations

The generating and transformer stations are approximately 1,800 feet



(1) Harrison St. station of Toronto Railway Co., which is one of the stations supplied with power by the Toronto Power Co. (2) Battery room at Harrison St. (3) Part of transformer room at Toronto Terminal station.



Interior view of Generating Station, Electrical Development Company, Niagara Falls, Ontario.

apart, and are connected by underground cables.

The transformer house is located on the top of the bluff, outside of the Park limits, and is designed to accommodate the following equipment:

Three, C.G.E. Co., 6,000 kw., type W.C., form E. I., 25 cycle, 60,000/40,000/86,500 Y—12,000/10,000/20,000 volt transformers.

Three, C.G.E. Co., type W.C., form E. I., 6,000 kw., 25 cycle. 50,000/86,500 Y/60,000—12,000/24,000 volt transformers.

Six, C.G.E. Co., Type W.C., form B. I., 2,670 kw., 25 cycle, 60,000/50,000/40,000—12,000—11,000— 10,000 volt transformers.

Three, C.G.E. Co., type W.G., form B. I., 2,670 kw., 25 cycle, 60,000/50,000—12,000—10,000 volts transformers.

The main Sub-Station is located at Toronto, and is designed to contain:—

Six, C.G.E. Co., type W.C., form E I., 5,500 kw., 44,000/76,000 Y/55,000 volts—12,000 volt transformers.

All power is distributed from this station by underground feeders to the various sub-stations throughout the city, the only exception being one or two small loads in the north end of the city.

In addition to the main terminal station at Toronto, there are also two sub-stations in the Niagara District, one located at Welland, and one at Thorold. The Thorold sub-station is equipped to contain:—

Six, C.G.E. Co., type W.C., form B. I., 2,400 kw., 25 cycle, 55,000—44,000/13,200—26,450 volt transformers.

The Welland sub-station is equipped to contain:—

Three, C.G.E. Co., type W.C., form B. I., 2,400 kw., 25 cycle, 55,000—44,000/13,000—26,450 volt transformers.

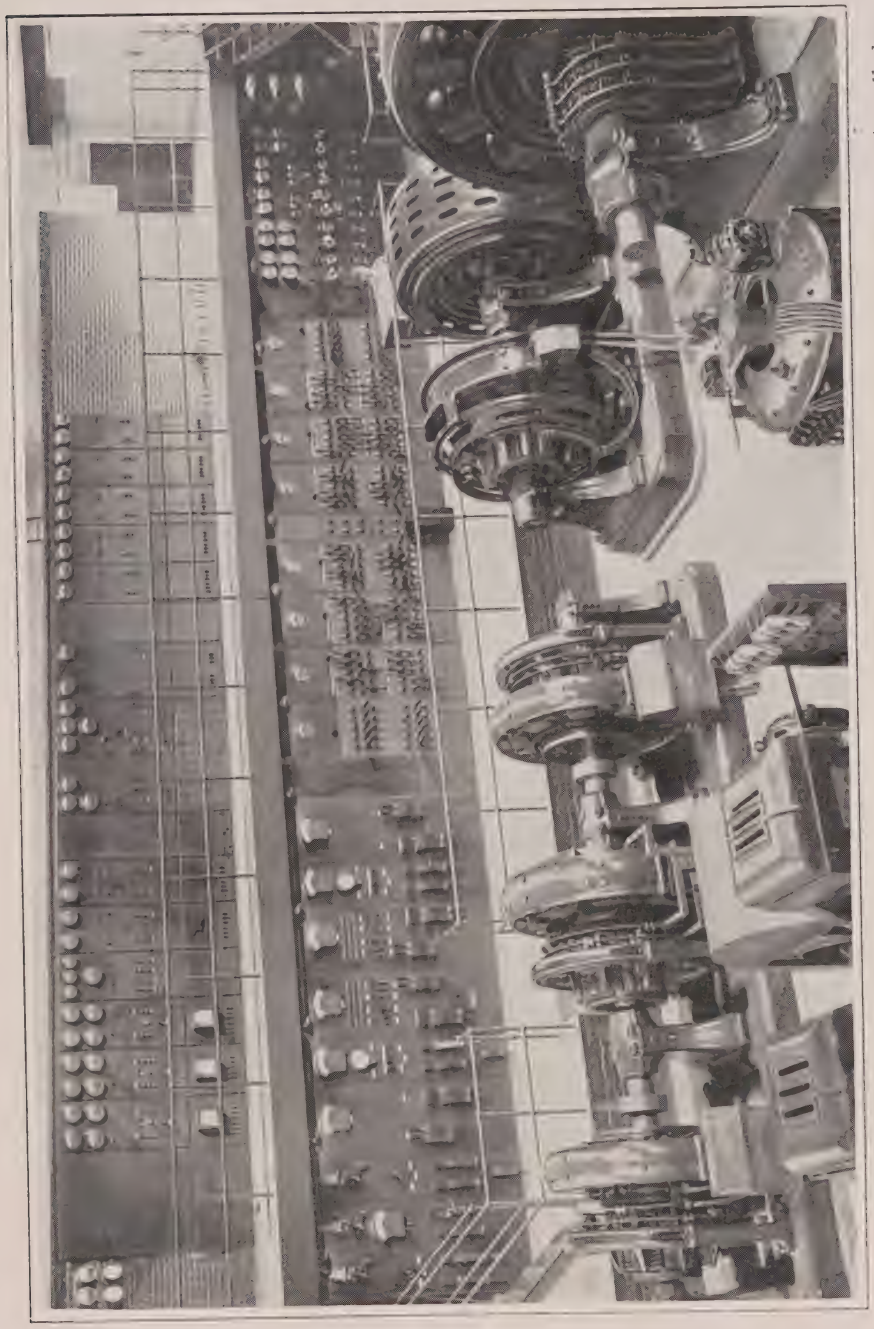
Transmission Lines

The transmission line to Toronto is constructed on a private right-of-way, which, in general, is 80 feet wide. One tower line only was first constructed. Construction work was commenced in 1903. This line consists of 40 feet steel towers with a double circuit of No. 190,000 circular mill, seven strand hard drawn copper cable. Pin type insulators were used with strain insulators at corners and special structures. A ⅜-inch galvanized stranded steel cable was erected some time after the line was constructed, and a special bayonet type support was attached to the centre of the tower for supporting the ground wire.

In 1913, a second steel tower line was erected from the Falls to Toronto, consisting of 53 feet steel towers equipped with ⅜-inch steel galvanized ground cable and two circuits of No. 190,000 circular mill, seven strand bare copper cable. This line was equipped with 90,000-volt pin type insulators with strain insulators at corners and special structures.

At the present time, the new power line is used practically altogether, but two circuits of the old line are used at 60,000 volts as far as Thorold and Welland, at which point wood pole line construction is used to connect with the Welland and Thorold sub-stations.

Across the Hamilton Beach, one of the circuits on the old power line has



Scott Street (Toronto) Station, showing part of the switchboard and some of the machines installed.

been re-insulated for 90,000 volts, and switching arrangements are provided for using this line in case of trouble on the new power line.

From the terminal station to New Toronto, the two circuits of the old power line are, at present, operated at 12,000 volts to supply sub-stations in that district.

A private telephone line is constructed on the right-of-way and connects the generating station with the Niagara Terminal Station.

T. E. L. Distributing System

The purchase deal has cleared up the dispute between the City of Toronto and the right of the company to use the streets for the distribution of power. The franchise of the old Toronto Electric Light Company was very limited and provided franchise rights in a small part of the business district only, the franchise rights being confined practically entirely to the use of an underground distributing system. On account of the objection taken by the City of Toronto to the franchise rights of the T.E.L. Company, the name of the distributing company was changed during the last few years to the Toronto and Niagara Power Company, and the latter company's franchise rights were claimed to be broad enough to include the use of the streets in the City of Toronto or any streets or roads in any municipality in the province.

The T.E.L. System has been to a large extent paralleled by the lines of the Toronto Hydro-Electric System, but this company still continues to serve approximately 28,500 customers and the power and lighting loads are well balanced and the system in general can be absorbed into the municipal system to very good advantage.

The arrangement of underground conduits and cables from the Toronto terminal station to power sub-stations and to Railway sub-stations will be of great value to the city when the Railway is taken over in September, 1921.

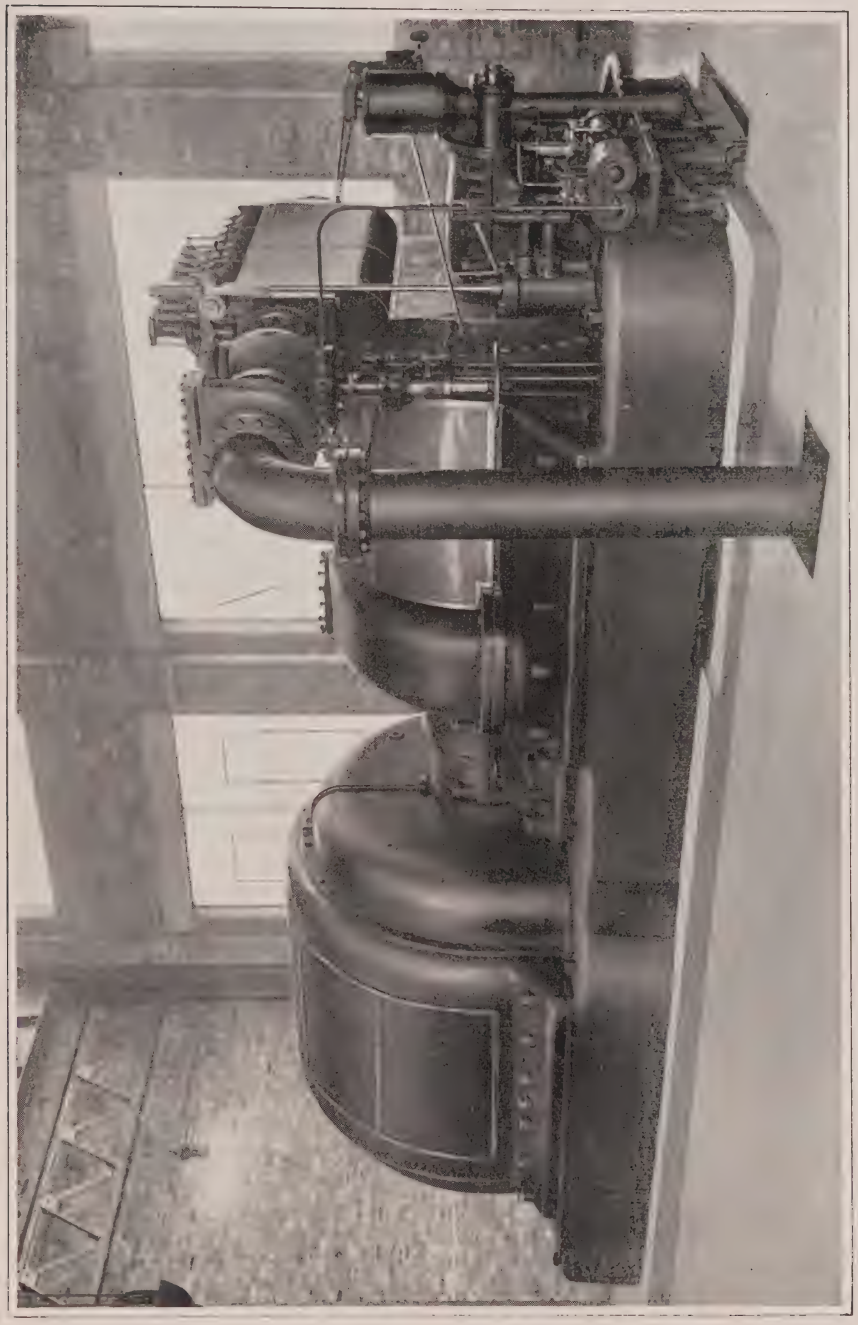
The sub-stations included as part of the distributing system are named as follows:—Chelsea Street, Cherry Street, Defoe Street, Dominion Bridge, Greenwood, Hickson, Huron, Mowatt, Natalie, River, Scott, Terauley, Yonge.

At the Scott Street Station is installed a steam plant having a capacity of approximately 15,000 horsepower, consisting of two 5,000 kw. Curtis turbines and one 2,000 vertical Curtis turbine.

The boiler equipment consists of 4 Babcock & Wilcox water tube boilers, 500 horsepower each, and a number of small Heine boilers, the total boiler capacity being approximately 8,000 horsepower. The overload capacity on the boilers would, of course, be sufficient to obtain full capacity from the installed turbines for short periods.

This station is also equipped with A.C. and D.C. motor generator sets, and a large storage battery, which is used in connection with supplying power to the D.C. distributing system, which is mainly confined to the business district of the city.

The Terauley Street sub-station is also equipped with a large storage battery and motor generator sets used to supply part of the D.C. distributing system.



One of the 5,000 k.w. Steam Turbine Sets at Scott Street Station, Toronto

Radial Railways

The Scarboro Division starts at the corner of Kingston road and King street, East Toronto, and runs along Kingston road for a distance of about ten miles, through fairly well populated sections. The section between the originating point and Stop 12 is growing very rapidly. A new car barn was erected in 1919 on Kingston road at Stop 18. They also have a park of about 100 acres at Stop 33. The Park, situated on the Lake Front is the property of the Railway Company, and is fenced in. A little development work has been carried out, the erection of a picnic pavilion, wells, and other accessories, playground equipment, etc. Quite a number of Sunday School picnics take advantage of this recreation ground. In 1920 about 9,000 Sunday School children picnicked in this park, this in addition to the regular Wednesday, Saturday and Sunday business. The line is single track, and the equipment consists of seven passenger cars, and the working equipment. The Scarboro Golf Club is situated along the Scarboro Division. The villages and towns situated along Scarboro Division are Birch Cliffe, Scarboro Junction and West Hill.

The second division is known as the Mimico Division. It runs from Sunnyside to Port Credit, over the Humber River and through Mimico, New Toronto, Long Branch, Rifle Ranges and Port Credit. This is a very fast growing section, there being erected in 1919 at Sunnyside 110 buildings, and 90 in 1920. At Mimico in 1919 there were 187 buildings erected and 185 in 1920. In New Toronto 30 buildings were erected, and in 1920 there were 54. In Toronto Township the building permits totalled in 1919:—$1,067,900.00, and in 1920:—$1,340,-560. In addition, there has been erected, the Goodyear Tire & Rubber Company's plant, and several other large manufacturing industries. This line takes care of a considerable travel to Lake View and Mississagua Golf Links. The Rifle Ranges also prove quite an attraction at certain seasons of the year. The St. Lawrence Starch Company in Port Credit is also one of the large industries located on this line. The Dupont Fabrikoid Company and the Brown Rolling Mills are located in New Toronto, with direct connection to the centre of the city. Considerable of this traffic which is diverted to other channels will ultimately become patrons to this line. This division is a single track for part of the distance, 3½ miles of new track being sufficient to double track the line from Sunnyside to New Toronto. The equipment consists of 17 cars.

The main portion of this line is the Metropolitan Division, which runs at present from Farnham avenue and Yonge street to Sutton and Lake Simcoe, a distance of 52 miles, of which 25 miles is on private right-of-way. The line ultimately, and pending construction of the proposed Hydro-Radial System will leave Stop 25, which is located just south of York Mills, the city extending the Yonge street car line to that point. This line passes through York Mills, Lansing, Willowdale, Kingsdale, Newtonbrook, Thornhill, Langstaff, Richmond Hill, Elgin Mills, Jefferson, Bond Lake, Oakridge, Aurora, Armitage, Newmarket, Sharon, Queensville, Gwillim-

burg District, Kedwick, Orchard Beach, Beaches Point, Eastbourne, Jackson's Point, Sutton, Bond Lake. This is situated at mileage 18 consists of a very pretty piece of property fairly well developed for picnics, and is 200 acres in extent. Part of it consists of a pretty little lake, whose shores are thickly wooded. Boat houses, picnic pavilion, swings, and other attractions are erected for the accommodation of the picnicers, and, last summer there were over 100 Sunday School picnics, with between 15,000 and 18,000 Sunday School children enjoying the benefits of this park. This, of course, is in addition to Sunday service, Saturdays, and holidays. Many manufacturing industries are located in close proximity to this line in the various towns, among the principal ones is the Office Specialty Company of Newmarket.

At Jackson's Point, for a distance of about 12 miles, the line parallels the shore of Lake Simcoe, which is growing very rapidly. Many beautiful summer homes have been erected in the last few years. About ten years ago property in this section sold for about $100 an acre, while to-day water-front property is bringing from $30 to $50 per foot. This promises to be one of the principal divisions of the proposed Hydro-Electric Railway System. Local baseball and hockey leagues have been organized for a number of years in the towns, which this line serves, and has created quite a bit of enthusiasm in these lines of sport, and, also, has been quite a revenue producer for the railway.

Schomberg and Aurora Division branches off from the Metropolitan Division at Bond Lake Junction, and runs to Schomberg, a distance of about 15 miles. This line depends principally upon the rural population for its business.

Rideau System

GENERAL—The Municipality of Kemptville recently passed the Hydro By-law, and steps will now be taken to supply power to the town. Negotiations for the purchase of the local plant are proceeding.

LANARK—The Municipality has signed contracts with a considerable number of customers for Hydro-Electric service, which it is proposed to install during the coming year.

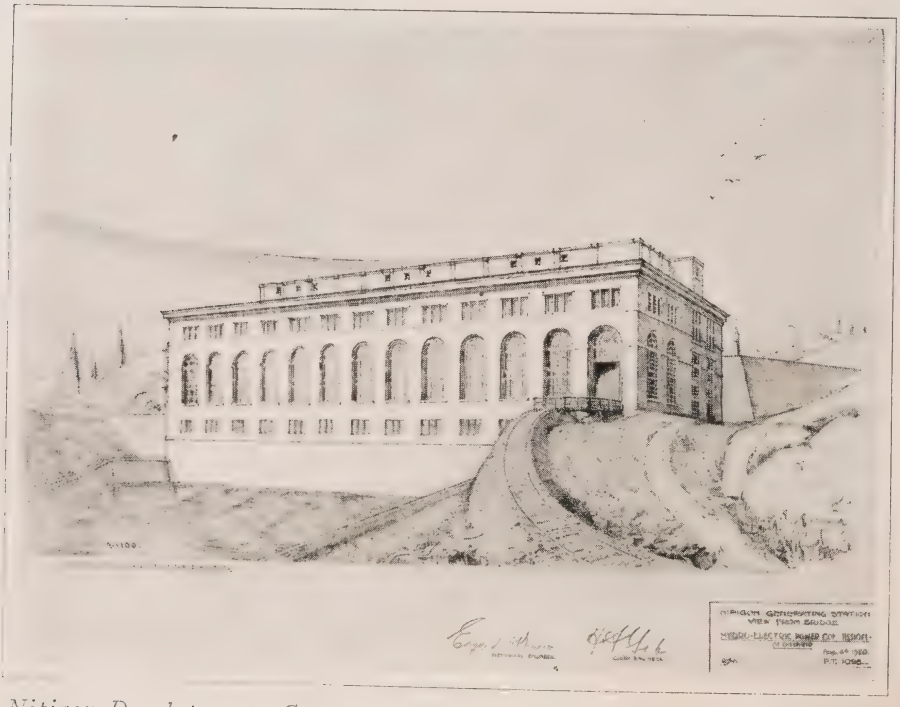
New Nipigon Power Development

THE Generating Station at Cameron's Falls on the Nipigon River and transmission line between the station and Port Arthur were both placed in service at midnight December 21st, and the Port Arthur load was taken over on that date.

As a description of this development was given in the April BULLETIN it is considered unnecessary to repeat the details of design in this issue, accompanying illustrations, however, represent the construction work in a more advanced stage than it was possible to give previously and these engravings have been reproduced from photographs taken in the field between October 20th and December 9th.

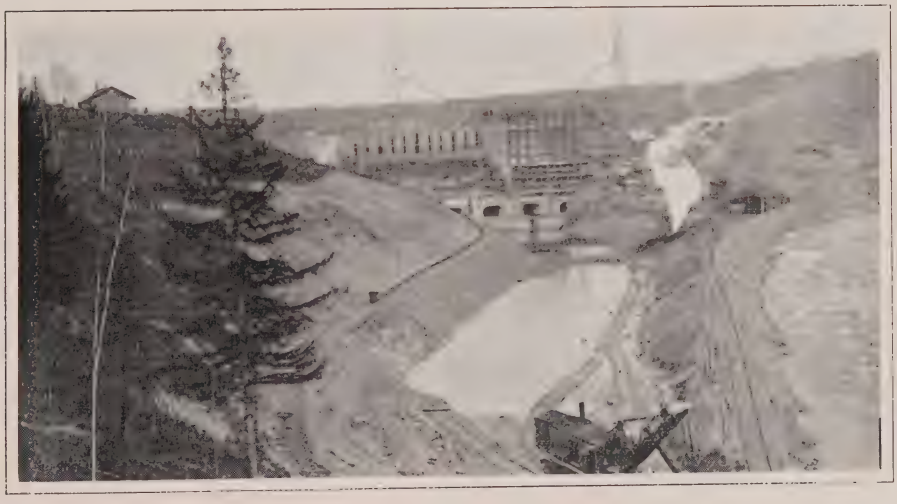
Great credit is due to the Construction Department in accomplishing the completion of the work to the extent of enabling the Commission to take over the Port Arthur load one day ahead of the contract and to give service in the Thunder Bay District from the Nipigon Plant one day previous to the expiration of the contract with the Kaministiquia Power Company.

The placing in operation of this development means at the present time the generation of approximately 7,000



Nipigon Development—Generating Station as it will appear when finally completed.

General view of Power House, November 25, 1920.



Power House from Tail-Race, October 16, 1920.

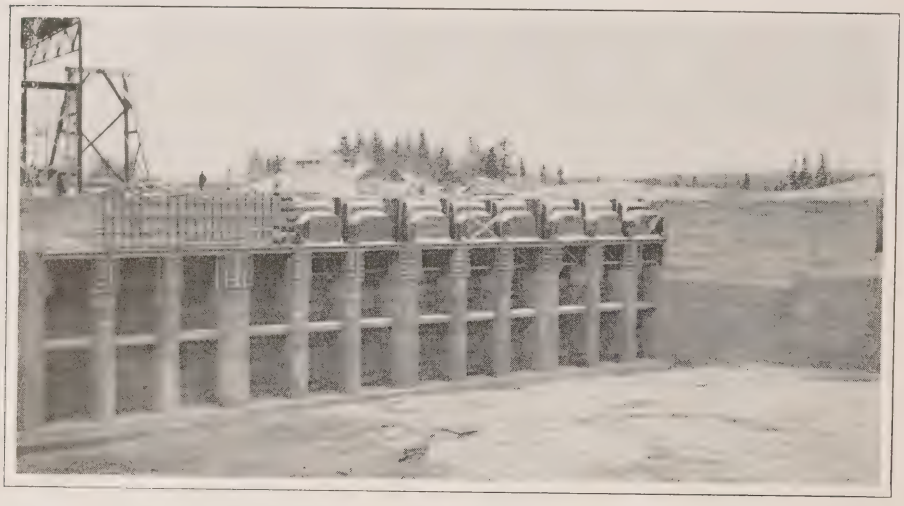
horsepower the stepping up of same to 63,500 volts, its transmission to Port Arthur, approximately sixty-seven miles, the retransformation of power to 22,000 volts and the delivery to the City of Port Arthur at the latter voltage.

One of the 12,500 horsepower units was placed in operation on December 21st and the second unit will be ready for operation on or about January 15, 1921. The Commission is arranging at the present time to purchase and install a third unit and possibly

a fourth, if load conditions in the immediate future warrant. The ultimate capacity of the plant as given previously being six units, giving a total capacity of 75,000 horsepower.

Due to the severe weather conditions prevailing in the district it has been found impossible to complete the concrete work on the Power House superstructure; this work, however, will be undertaken in the spring, as soon as weather conditions permit.

The accompanying views give an idea of the appearance of the com-



Forebay and Headworks, December 5, 1920.

Temporary Dam, December 7, 1920

pleted Power House Building, as well as the partially completed structure.

The Dam at this Development is also given in an accompanying illustration and consists of "crib" construction. This Dam is only temporary at the present time, and the main Dam will be put in later and will be of concrete construction.

The entire plant was placed in operation without any difficulties being experienced, either at the generating plant or on the sixty-seven miles of transmission line, or at the Port Arthur Terminal Station.

In order that the Municipality of Port Arthur could take this power and distribute it satisfactorily it was necessary for the Commission to give the local officials assistance in constructing a line from the terminus of the Nipigon transmission line at the Water Works Pumping Plant to the main Terminal Station in the centre of the city.

It is expected that the load in Port Arthur by June, 1921, will approximate 10,000 horsepower, which together with the 3,000 horsepower to be delivered to the Nipigon Fibre and Paper Company at Nipigon Village on or about March 1, 1921, will give a load for the first year on the Nipigon Development of approximately 13,000 horsepower. There is a very strong possibility of the load on this plant increasing to approximately 50,000 horsepower in the next two or three years and additional units will be added to the Development at Cameron's Falls from time to time as fast as the demand for power is created.

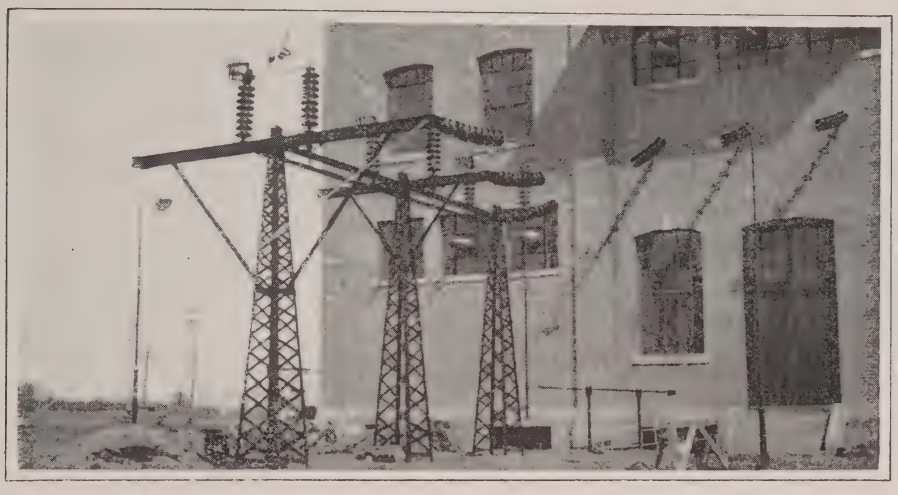
Hydro Power in the St. Lawrence District

Cornwall High Tension Station.

SINCE an adequate supply of power was secured for the St. Lawrence System by the inauguration in May, 1919, of Cedars Rapids power from the Commission's high-tension station near Cornwall, the growth of the system load has been rapid.

At that time the load taken by municipalities connected with the system was about 1,100 horsepower. The present municipal load is in excess of twice that amount. The major portion of the increase in load, however, is due to manufacturing plants in the vicinity of Cornwall. In September, 1918, the Toronto Paper Company which manufactures a line of high grade papers at its plant just west of Cornwall, entered into a contract with the Commission for 300 horsepower, with provision for increasing this amount to 5,000 horsepower. Up to the present this load has increased from 300 to 700 horsepower. The company has now made definite application for the total allotted amount of 5,000 horsepower, and has requested a further supply of 2,500 horsepower if it can be made available on the system.

The Cornwall Pulp and Paper Company, whose parent company is the Niagara Wallboard Company of Buffalo, New York, is preparing to enter into a contract for 3,000 horsepower, and has requested an additional supply of power at a later date, if it can be procured. This company chose a power site at Cornwall, after considering several others, on account of the favorable location and the reliable supply of power available at this point. An old saw-mill located along the St.



Cornwall High Tension Station.

Lawrence Canal east of the main street has been purchased by the company.

Power will be delivered to the company at 26,400 or 44,000 volts, depending upon the voltage carried on the St. Lawrence system lines. The transformers installed in the company's sub-station will be similar in rating to those used by the Commission, so that interchanges may be arranged to prevent prolonged interruption of service. It is proposed to install a bank of two 1,500-Kva., 3-phase transformers, with provision for further extension when load conditions warrant an increase. The company has purchased from the Commission the 60-cycle portion of a 1,250 Kva. frequency changer set

formerly used at Durham. This will be used as a synchronous motor in the main plant of the company. This motor is rated at 2,200 volts, and it is proposed to use one of the substation transformers to supply it with power. Other motors of smaller size are rated at 550 volts, and will receive supply from the other transformer.

The motor will be on the company's property before the end of December, and the company will be ready to receive power by the end of January. At the start the load will amount to 2,200 horsepower and grow rapidly to the maximum of 3,000 horsepower. The Commission proposes to put a construction gang, which is available in the district, on the work of constructing lines to supply the company.

The Cornwall High-Tension Station, as completed early in 1919, is a fireproof brick and steel structure, 52 by 67 feet, situated about 3 miles west of the town, at the point where the lines of the Cedar Rapids Transmission Company cross the St. Lawrence River into the State of New York.

The electric equipment consists of two incoming 110,000-volt lines with an oil switch on each line, and four single phase, 1,250 Kva., 60-cycle, 63,500, 26,400-volt, water cooled transformers, with protective apparatus. Provision was made for extending the station when the load conditions should call for increased capacity. In the light of present conditions, and anticipating the needs of municipalities in the near future, it has been decided to extend the transformer station, installing, in addition to the present equipment four 5,000-Kva. transformers, one of which will be used as a spare. Until this work can be carried out, temporary service will be given from three 750-Kva., 25-cycle outdoor-type transformers, borrowed from the Niagara System.

The transmission line from the high-tension station to the Toronto Paper Company's plant, was constructed under war conditions and minimum material costs. For this reason 7/16 inch steel conductor was used. It is now proposed to change this conductor to No. 6-0 aluminum, and to carry this same gauge to the plant of the Cornwall Pulp and Paper Company, requiring about 1½ miles of pole line additional.

Enquiries have been received from several prospective power users, for large blocks of power, but for the present no further contracts can be executed, as all power under existing agreements has been taken up. The Commission is negotiating for further supplies to supplement the 10,000 horsepower now available.

Technical Section

Cement, Its Inspection and Testing

By E. J. Mason

Engineering Materials Laboratory, Hydro-Electric Power Commission of Ontario

ALL cement purchased by the Commission must pass certain specifications before it is finally accepted for use. This requires the sampling and testing of the cement at the time of shipment. This work is handled by a division of the Laboratories at Toronto.

The supervision of cement purchased begins at the cement mill which has standing instructions that all shipments of cement consigned to the Commission must be inspected and sampled before shipment. The Laboratories maintain a representative at each mill to do this work.

Cement is commonly purchased by the barrel (4 bags) and shipped in carload lots of 700 to 1,200 bags. Each carload is sampled by taking a small portion of cement from each fortieth bag at the time the car is loaded. The portions thus taken are mixed together to form an individual sample of approximately 15 pounds which represents the entire car.

Having obtained the sample from a car, the inspector seals the car with special Hydro seals and signs the bill of lading showing that the car has been inspected. He then inserts in the sample such necessary information as may be needed to identify the car from which the sample was taken. The sample is then sent by express to the Laboratories, and the consignee notified that shipment has gone forward.

A few cement mills have bins of such size and so arranged that they may be filled and emptied without interfering with the normal operation of the plant. This condition is generally taken advantage of if the quantity of cement purchased is large, as then bin sampling can be resorted to. For bin sampling, samples are taken periodically as the bin is being filled. These samples are then sent to the Laboratories and given the regular tests. If the test results are satisfactory, the entire bin is accepted. Cars may then be filled with this accepted cement, sealed and shipped without

further sampling. A record is made showing from which bin each shipment is loaded. The Laboratories can then refer to their tests on the cement from that bin and can advise the parties interested of the quality of cement in that car. When possible, bin sampling is to be recommended as the most satisfactory and economical.

Time is an important factor in the testing of cement. There is a lapse of at least seven days after receipt of the sample at the Laboratories before the results of the tests on the sample can be reported to the field. During this lapse of time the car is proceeding to the job, and unless the test results are ready at the time the car arrives, demurrage may cause considerable additional expense. It is therefore essential that the samples be delivered to the Laboratories as soon as possible after having been collected. Bin sampling referred to above practically eliminates the delays which are sometimes unavoidable when the tests must be made while the shipment is in transit. By keeping constantly in touch with the express companies carrying the samples, the Laboratories endeavor to have all samples delivered to them within from twelve to twenty-four hours after collection at the mill. The time elapsing depends, of course, on the location of the mill and the train service available between there and the Laboratories.

Upon receipt at the Laboratories the sample is immediately taken in hand by an operator whose duty it is to make tests for normal consistency, time of setting, soundness, strength and fineness of the cement.

Normal Consistency.

Normal consistency is made to determine the proper quantity of water to be used in the subsequent tests. It is determined by what is known as a Vicat Apparatus which consists of a needle of standard weight and form and a conical cylinder into which the neat cement paste is introduced. In making the test the operator mixes the cement with a measured quantity of water, fills the mould with this paste and observes the penetration of the weighted needle. The penetration sought is 10 millimeters in 30 seconds. If it is found to be more, the test is repeated, mixing the cement with less water, if found to be less, more water is used. The quantity giving the desired penetration is called the normal consistency of that cement.

Time of Setting.

In construction work it is not always possible to deposit a batch of concrete immediately after it has been mixed and it is therefore necessary to be able to detect a cement which has a "flash" or rapid set. It is equally important that a cement should not be too slow in setting as this may delay construction. To guard against these two extremes, it is necessary to determine the time within which a cement develops its "initial" and "final" set. The same Vicat apparatus and mould used for determining normal consistency is also used for determining the time of setting, with the exception that the needle for the latter is much smaller than the needle used for the former. Initial and final set are supposed to represent the points at which cement begins and completes setting. Both are measured by the penetration

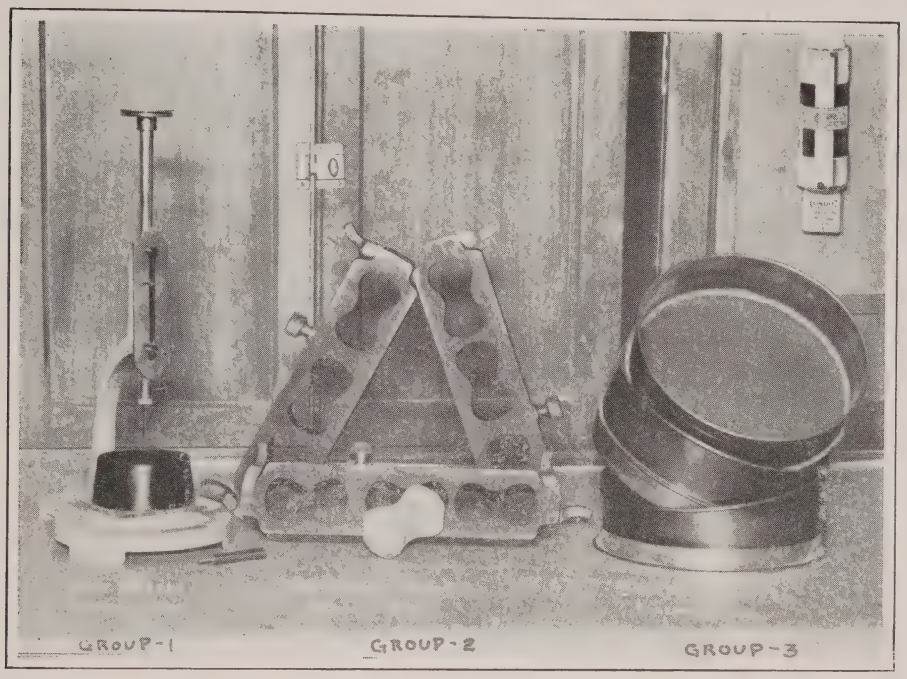


Figure I.

or lack of penetration of the Vicat needle into a normal consistency paste.

Figure 1, group 1, shows the apparatus used for determining normal consistency and time of setting. As shown the apparatus is prepared for a setting test, the needle used for normal consistency test is shown in the foreground.

SOUNDNESS.

From the surplus material used in the normal consistency tests, two small "pats" are made. These "pats" are circular, about 3 inches in diameter and ½ inch thick at the centre and taper to a thin edge at the circumference. They are placed on square glass plates and covered for twenty four hours to prevent rapid drying out. At the end of twenty four hours one of the pats is placed in boiling water, the other pat in steam at atmospheric pressure for five hours. This test is used to detect unsound and immature cement. Figure 3, a photograph of a portion of a pat, shows its effect on a pat made from a sample of unsound cement. A good cement would reveal no crack or crazing. Figure 2 shows an electrically heated boiler used for the test. The bottle at the left is used to replace the water which passes off as steam and to maintain the water in the boiler at a constant level.

STRENGTH.

For the strength tests, six briquettes are made of the shape shown by the briquette and moulds in Figure 1, group 2. These briquettes are 3 inches in length and have a cross section of exactly one square inch at the narrowest section. The briquettes increase in width toward the ends to

allow the grips of the testing machine to obtain a secure hold on the specimen.

The briquettes are moulded by hand from a mixture of one part cement to three parts Standard Sand by weight. The Standard Sand used is an almost pure silica sand mined at Ottawa, Illinois. The grading of the sand is extremely uniform, the average diameter of the particles being approximately .029-inch. Figure 4 will convey some idea of the size and uniform grading of this sand.

After the briquettes have been moulded they are kept for the first twenty four hours while they are setting, in moist air. They are then taken from the moulds, marked for identification and placed in pans of fresh water, the temperature of which is kept at 70° Fah.

When the briquettes are seven days old, two are broken in tension. The remaining are left in the water until they are twenty eight days old when they also are tested. Briquettes made and cured as described must develop the following tensile strengths in order to pass specifications.

Age when tested	Tensile Strengh Lbs. per sq. in.
7 days	200
28 days	300

Figure 5 shows the machine used for tensile tests with a briquette in position ready for testing.

Fineness.

Investigations have shown that only the very finely ground portion of a cement has cementing properties. It is therefore important to know the fine-

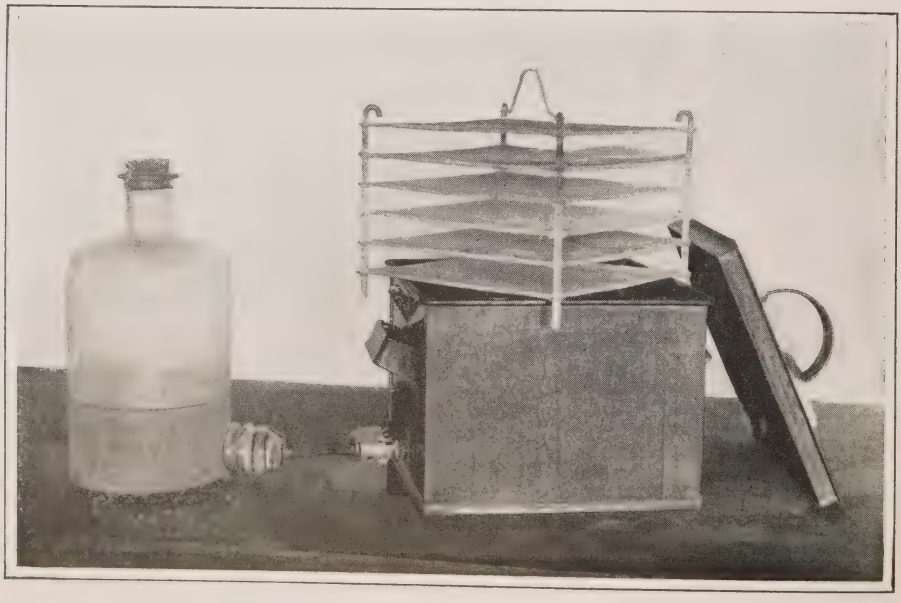


Figure II.

ness of a cement. This is ascertained by passing a sample through a standard sieve which has 200 openings per lineal inch or 40,000 per square inch. To be of the required fineness 78 per cent. of the cement must pass through this sieve. The equipment for this test is shown in Figure 1, group 3.

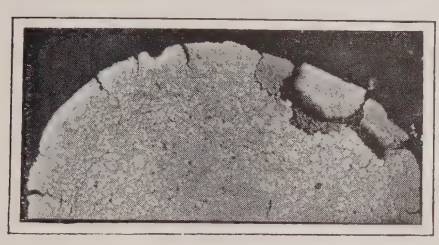


Figure III.

With the exception of the twenty eight day tensile tests, all tests are complete when the seven-day strength tests are finished and a complete report upon the results of the tests at hand is at once made to all parties interested. This report advises them of the quality of the cement in the car represented by the sample tested and recommends either that the cement be accepted, rejected or held for completion of the final tests, as the results warrant. Cement may be rejected for failing to satisfactorily pass any one of the tests mentioned.

A review of the experience of the Laboratories covering tests of some 1,600 cement samples reveals the fact that although failures are not common their number is not negligible and the attention given to each shipment has been warranted and has prevented many carloads of questionable or faulty cement from being used on the Commission's work. Failures have not been confined to any particular cement although cements from different sources often have characteristic merits or weaknesses.

The rejection of a cement shipment is a serious thing and the laboratory before recommending such a course must be very sure that the cement and not the tests are at fault. In the Laboratories every detail in connection with the testing of cement, the temperatures of the rooms, of the mixing water used and of the storage, is watched continuously. The accuracy of the testing machines is checked periodically. Finally, since so much depends on the men carrying out the different tests, no one is allowed to make any cement tests until he has proved by a long apprenticeship that he has the requisite amount of skill.

The Laboratories, as at present equipped, have a capacity of 150 tests per week and can handle on any one

Figure IV.

day as many as 40 complete tests. Inspection and testing is carried out not only for the Commission but to some extent for the municipalities associated with it. In all cases commercial rates are charged for the service.

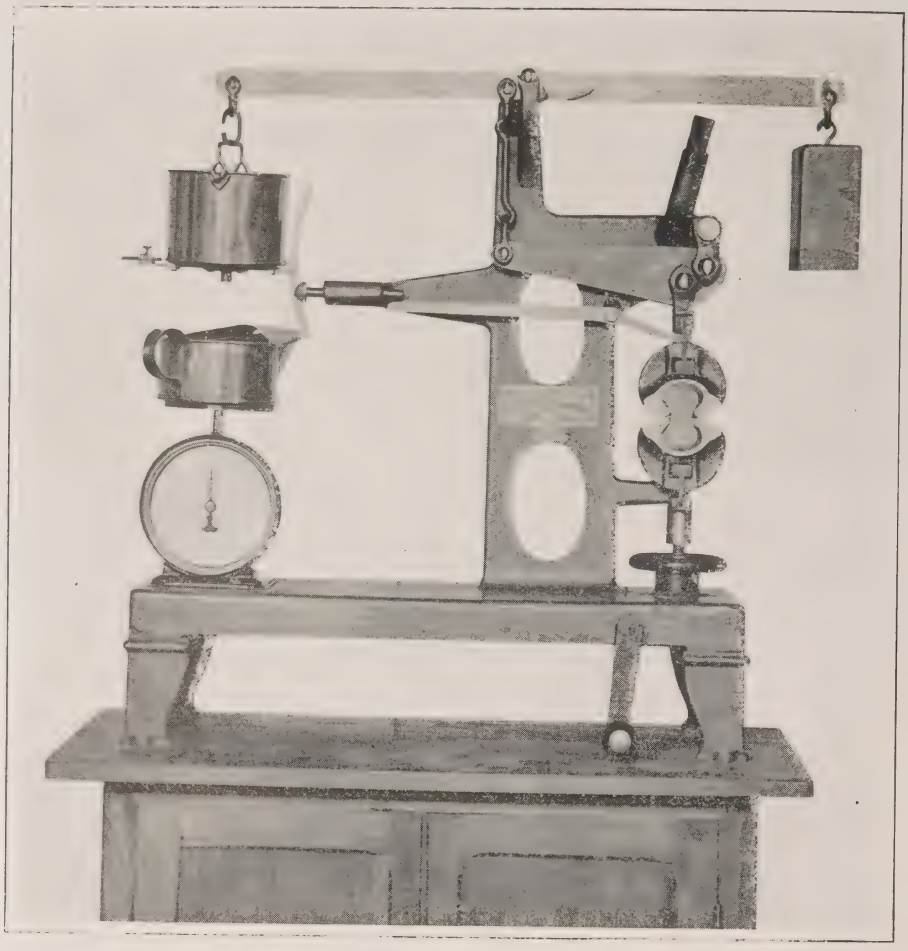
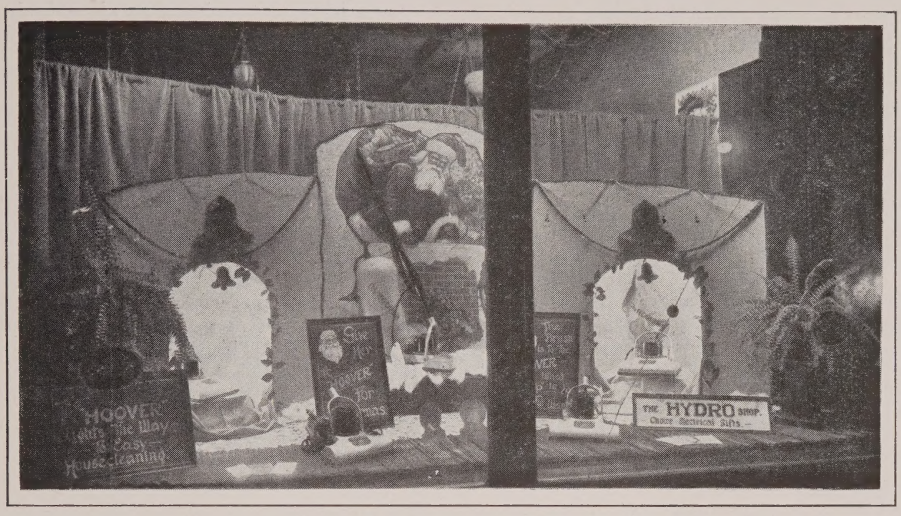


Figure V.

Electrical Energy from Waves

Even the sea is to be harnessed for the production of electrical energy, according to reports which come from the west coast of England. Here a number of estuaries have been surveyed with a view to installing turbines which work by the tidal ebb and flow. The tide makes the power at both its inflow and its outflow, only ceasing for a comparatively short time during the period of half tide. In certain districts the great variation in the hour of the tide at neighboring estuaries makes possible the production of maximum energy during an almost continuous period.—*Journal of Electricity.*



Attractive Christmas window display, featured by the Commission's Office in Belleville.

Hydro-Electric Club Dance

THE newly formed "Ontario Hydro-Electric Club" composed of members of the staff of the Commission, held its first dance in the Masonic Temple, Yonge street, on Thursday, December 9th.

The affair was an unqualified success and the enthusiasm shown on this occasion augurs well for any future events of a similar nature. In fact the Committee which had charge of the dance has already received numerous requests for information regarding the time and place of the next dance.

The patronesses were Lady Beck, Mrs. I. B. Lucas, Mrs. D. Carmichael and Mrs. W. W. Pope.

Nearly five hundred guests, comprising the members of the staff and their friends, filled the spacious auditorium and judging by the repeated calls for encores, thoroughly enjoyed the music of a splendid six-piece orchestra.

The hall was decorated with six large Union Jacks draped around the balcony and in the central section was a large shield with the letters "O.H.E. Club," designed and colored by Mr. Richards of the Electrical Engineering Draughting Room.

A buffet lunch was served from long tables along one side of the auditorium, prettily decorated with roses and carnations.

An enjoyable feature of the evening was the balloon dance. Two hundred brightly colored balloons were tossed down on the heads of the dancers and in the lively scramble to secure possession of these balloons

dignity was completely forgotten. Messrs. E. T. Brandon and M. V. Sauer were noticed trying to capture the same elusive balloon, but owing to the fact that nature had provided him with greater "altitude" the gentleman from the Hydraulic Department secured the desired prize. Mr. T. C. James was one of the many who came to "dance just a few" and instead didn't miss a single number. Mr. E. F. Latimer suggests that in future the dances be made shorter and have more of them so that he can have a dance with all the young ladies present.

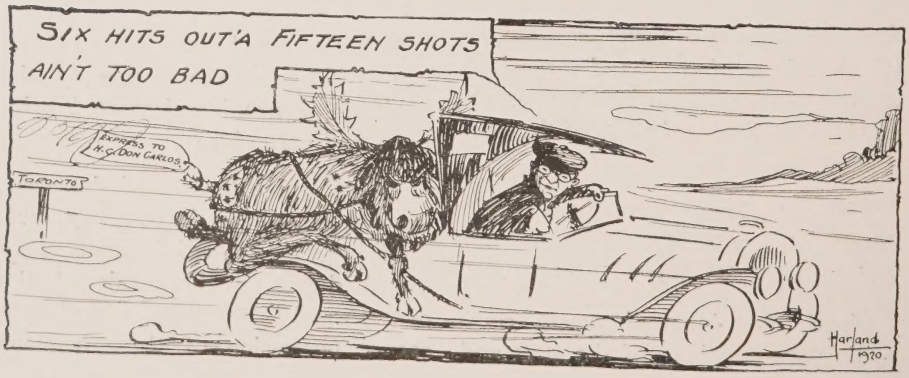
Mere words fail to describe some of the *wonderful creations* worn by the ladies and in fact the masculine element was so completely captured that a new low record for standing out and "smoke" dances was established.

A progressive euchre tournament was held for those who did not dance, the lady's prize being won by Mrs. Pyle and the gentleman's prize by Mr. G. Hay.

In addition to the friends of the staff, the following prominent visitors were present:—Mr. and Mrs. Geo. Leacock, Mr. T. Gass, Mr. and Mrs. C. C. Bothwell, Mr. and Mrs. Stan McCordick, Mr. and Mrs. Cooper, Mr. and Mrs. W. Greenshields and Mr. Hopper.

The out-of-town guests included Mr. W. H. Childs and party from Hamilton, Mr. and Mrs. Gordon Kribs of Hespeler and Mr. J. Brennan of Hamilton.

The Dance Committee consisted of Miss R. McQuire, Mr. G. Floyd and Mr. Jack Morgan, Chairman, assisted by Messrs. Vogan, Hare, Millar and Lennox, and they wish to thank the staff for the very hearty co-operation and support which was given by everyone in their efforts to make the first club dance an undoubted success. The Committee, also, reports a small surplus on hand which will be the nucleus of a fund towards the proposed club house.



HYDRO MUNICIPALITIES

NIAGARA SYSTEM

Acton	1,563
Ailsa Craig	447
Ancaster	400
Ancaster Twp.	4,621
Aylmer	2,177
Ayr	809
Baden	710
Barton Twp.	8,029
Beachville	503
Biddulph Twp.	1,763
Blenheim	1,533
Bolton	675
Bothwell	700
Brampton	4,238
Brantford	28,725
Brantford Twp.	8,061
Breslau	500
Brigden	400
Burford	700
Burford Twp.	3,845
Burgessville	300
Caledonia	1,150
Chatham	15,030
Chippawa	1,095
Clinton	1,948
Comber	800
Copetown	230
Dashwood	350
Delaware	350
Dereham Twp.	3,233
Dorchester	400
Dorchester S. Twp.	1,389
Drayton	622
Dresden	1,413
Drumbo	375
Dublin	218
Dundas	5,078
Dunnville	3,402
Dutton	858
Elmira	2,238
Elora	1,122
Embro	481
Etobicoke Twp.	6,586
Exeter	1,431
Fergus	1,609
Flamboro E. Twp.	2,443
Forest	1,418
Galt	12,558
Georgetown	2,010
Glencoe	865
Goderich	4,562
Grantham Twp.	3,242
Granton	300
Guelph	16,974
Hagersville	1,058
Hamilton	110,137
Harriston	1,381
Hensall	715
Hespeler	2,929
Highgate	379
Ingersoll	5,278
Kitchener	19,767
Lambeth	350
Listowel	2,437
London	58,421
London Twp.	5,744
Louth Township	2,214
Lucan	640
Lynden	662
Markham	813
Merritton	2,358
Milton	1,750
Milverton	929
Mimico	2,490
Mitchell	1,672
Moorefield	335
Mount Brydges	500
New Hamburg	1,356
New Toronto	2,551
Niagara Falls	12,434
Niagara-on-the-Lake	2,014
Norwich	1,262
Norwich N. Twp.	2,011
Norwich S. Twp.	1,814
Oil Springs	548
Otterville	400
Palmerston	1,815
Paris	4,866
Parkhill	1,202
Petrolia	2,954
Plattsville	500
Point Edward	984
Port Colborne	2,987
Port Credit	1,100
Port Dalhousie	1,391
Port Stanley	732
Preston	4,966
Princeton	600
Ridgetown	2,180
Rockwood	520
Rodney	656
Sandwich	3,448
Sarnia	12,178
Scarborough Twp.	6,566
Seaforth	2,027
Simcoe	3,818
Springfield	426
St. Catharines	19,189
St. George	600
St. Jacobs	400
St. Mary's	3,807
St. Thomas	17,209
Stamford Twp.	3,702
Stratford	17,143
Strathroy	2,687
Streetsville	475
Tavistock	917
Thamesford	388
Thamesville	808
Thorndale	250
Tilbury	1,623
Tillsonburg	2,788
Toronto	489,681
Toronto Twp.	4,782
Townsend Twp.	3,291
Vaughan Twp.	4,090
Walkerville	5,914
Wallaceburg	3,922
Waterdown	790
Waterford	985
Waterloo	5,105
Waterloo Twp.	6,378
Watford	1,133
Welland	9,876
West Lorne	700
Wellesley	583
Weston	2,495
Windsor	29,344
Woodbridge	600
Woodstock	10,051
Wyoming	495
Zurich	457
Total	1,122,472

SEVERN SYSTEM

Alliston	1,224
Barrie	6,775
Beeton	492
Bradford	866
Camp Borden	.....
Coldwater	584
Collingwood	7,849
Cookstown	635
Creemore	615
Elmvale	600
Midland	7,339
Orillia	8,058
Penetang	3,664
Port McNichol	564
Stayner	870
Thornton	200
Tottenham	475
Victoria Harbor	1,496
Waubaushene	600
Total	42,906

WASDELL'S SYSTEM

Beaverton	932
Brechin	225
Brock Twp.	2,871
Cannington	818
Eldon Twp.	2,085
Gamebridge	70
Kirkfield	138
Mara Twp.	2,486
Sunderland	570
Thorah Twp.	1,116
Woodville	400
Total	11,711

NIPISSING SYSTEM

Callander	650
Nipissing	100
North Bay	9,413
Powassan	519
Total	10,682

MUSKOKA SYSTEM

Gravenhurst	1,502
Huntsville	2,113
Total	10,682

EUGENIA SYSTEM

Alton	450
Artemesia Twp.	2,392
Arthur	1,027
Chatsworth	257
Chesley	1,703
Derby Twp.	1,577
Dundalk	700
Durham	1,500
Elmwood	350
Flesherton	378
Grand Valley	558
Hanover	3,225
Holstein	285
Horning's Mills	350
Kilsyth	.....
Markdale	925
Mount Forest	1,716
Neustadt	412
Orangeville	2,173
Owen Sound	11,768
Shelburne	970
Tara	520
Total	33,236

OTTAWA SYSTEM

Ottawa	104,007

THUNDER BAY SYSTEM

Port Arthur	15,100

CENTRAL ONTARIO SYSTEM

Belleville	12,345
Bloomfield	500
Bowmanville	2,853
Brighton	1,387
Cobourg	4,835
Colborne	939
Deloro	347
Deseronto	2,117
Kingston	23,737
Lindsay	7,880
Madoc	1,146
Millbrook	746
Napanee	2,864
Newburgh	426
Newcastle	552
Omemee	467
Orono	700
Oshawa	9,748
Peterborough	20,904
Picton	3,257
Port Hope	4,311
Stirling	823
Trenton	6,107
Tweed	1,292
Wellington	802
Whitby	3,471
Total	114,556

ST. LAWRENCE SYSTEM

Brockville	9,418
Chesterville	925
Prescott	2,660
Williamsburg	200
Winchester	1,047
Total	14,250

RIDEAU SYSTEM

Carleton Place	3,844
Perth	3,545
Smith's Falls	6,356
Total	13,745

ESSEX COUNTY SYSTEM

Amherstburg	2,386
Canard River	50
Cottam	333
Essex	1,753
Harrow	619
Kingsville	1,567
Leamington	3,907
Total	10,615

THOROLD SYSTEM

Thorold	4,325

Frequencies: Niagara, Thorold and Essex County Systems—25 cycles; all other Systems—60 cycles.

THE aim of The Bulletin is to provide municipalities with a source of information regarding the activities of the Commission; to provide a medium through which matters of common interest may be discussed, and to promote a spirit of co-operation between Hydro Municipalities.